CLAIMS

1. A method for the preparation of a plasma-polymerised layer on at least a part of the surface of a substrate, said method comprising the steps of:

(a) providing the substrate;

(b) providing one or more compounds to become plasma-polymerised to form said layer;

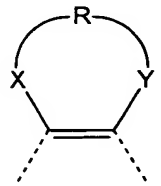
(c) providing a gas plasma; and

(d) allowing said compound(s) to react within said gas plasma so as to form said plasma-polymerised layer on said substrate;

said one or more compounds including at least one polycyclic compound, said polycyclic compound(s) comprising a non-aromatic heterocyclic ring fused to an aromatic or heteroaromatic ring or ring system.

2. The method according to claim 1, wherein the non-aromatic heterocyclic ring has 4-8 ring atoms.

3. The method according to any one of the preceding claims, wherein the non-aromatic heterocyclic ring is of the type



wherein X and Y independently are selected from the group consisting of =C<, >C<, -C(=O)-, -C(=N-)-, -O-, -S-, -N= and $-NR^N-$ where R^N is selected from hydrogen and C_{1-4}-alkyl, with the proviso that at least one of X and Y is selected from –O–, –S–, –N= and $-NR^N-$.

4. The method according to any one of the preceding claims, wherein the non-aromatic heterocyclic ring is selected from the group consisting of a 1,4-dioxane ring, a 1,3-dioxane ring, a morpholine ring, a tetrahydrofuran ring, a 1,3-dioxolane ring, a 1,3-oxazolidine ring, a pyrrolidine ring, a piperidine ring, a piperazine ring, a tetrahydro-2H-thiopyran ring, a 1,4-thioxane ring, a 1,3-thioxane ring, a tetrahydrothiophene ring, a 1,3-oxathiolane ring, a

thiazolidine ring, a thiomorpholine ring, a 1,3-thiazinane ring, a 2,3-dihydrofuran ring, a 4,5-dihydro-1,3-oxazole ring, and a 4,5-dihydro-1,3-thiazole ring.

5. The method according to any one of the preceding claims, wherein the aromatic or heteroaromatic ring or ring system is selected from the group consisting of a thiophene ring, a benzene ring, a pyrrole ring, a furan ring, a naphthalene ring, a quinoline ring, an iso-quinoline ring, a pyridine ring, a pyrimidine ring, a pyrazine ring, a pyridazine ring, a 1,2,4-triazine ring, an imidazole ring, an isoxazole ring, an oxazole ring, a pyrazole ring, a 1H-1,2,3-triazole ring, an isothiazole ring, a thiadiazole ring, a thiazole ring, a thianaphthene ring, an iso-thianaphthene ring, a quinone ring, an anthraquinone ring, a benzofurane ring, a benzothiophene, an indole ring, and a 1,4-naphthoquinone ring.

6. The method according to any one of the preceding claims, wherein the aromatic or heteroaromatic ring or ring system comprises a heteroaromatic ring.

7. The method according to any one of the preceding claims, wherein the one or more compounds include at least one compound selected from the group consisting of 3,4-ethylenedioxythiophene, piperonylamine, piperonyloyl chloride, safrole, 3,4-ethylene-dioxypyrrole, 3,4-ethylenedioxy-N-methylpyrrole, and 3,4-methylenedioxythiophene.

8. The method according to any one of the preceding claims, wherein the substrate is selected from organosiloxane-based materials, glasses, silicon and fluoro-polymers.

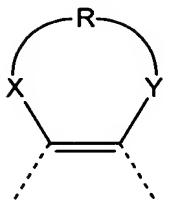
9. The method according to any one of the preceding claims, wherein the energy deposited in the gas plasma is less than 2.0 W/L.

10. The method according to any one of the preceding claims, wherein the plasma-polymerised layer has a thickness of in the range of 5-200 nm.

11. An object comprising a substrate having a layer of one or more plasma-polymerised compounds on at least a part of the surface thereof, at least one of said compounds comprising a non-aromatic heterocyclic ring fused to an aromatic or heteroaromatic ring or ring system.

12. The object according to claim 11, wherein the non-aromatic heterocyclic ring has 4-8 ring atoms.

13. The object according to any one of claims 11-12, wherein the non-aromatic heterocyclic ring is of the type



wherein X and Y independently are selected from the group consisting of =C<, >C<, -C(=O)-, -C(=N-)-, -O-, -S-, –N= and $-NR^N-$ where R^N is selected from hydrogen and C_{1-4}-alkyl, with the proviso that at least one of X and Y is selected from –O–, –S–, –N= and $-NR^N-$.

14. The object according to any one of the claims 11-13, wherein the non-aromatic heterocyclic ring is selected from the group consisting of a 1,4-dioxane ring, a 1,3-dioxane ring, a morpholine ring, a tetrahydrofuran ring, a 1,3-dioxolane ring, a 1,3-oxazolidine ring, a pyrrolidine ring, a piperidine ring, a piperazine ring, a tetrahydro-2H-thiopyran ring, a 1,4-thioxane ring, a 1,3-thioxane ring, a tetrahydrothiophene ring, a 1,3-oxathiolane ring, a thiazolidine ring, a thiomorpholine ring, a 1,3-thiazinane ring, a 2,3-dihydrofuran ring, a 4,5-dihydro-1,3-oxazole ring, and a 4,5-dihydro-1,3-thiazole ring.

15. The object according to any one of the claims 11-14, wherein the aromatic or heteroaromatic ring or ring system is selected from the group consisting of a thiophene ring, a benzene ring, a pyrrole ring, a furan ring, a naphthalene ring, a quinoline ring, an iso-quinoline ring, a pyridine ring, a pyrimidine ring, a pyrazine ring, a pyridazine ring, a 1,2,4-triazine ring, an imidazole ring, an isoxazole ring, an oxazole ring, a pyrazole ring, a 1H-1,2,3-triazole ring, an isothiazole ring, a thiadiazole ring, a thiazole ring, a thianaphthene ring, an iso-thianaphthene ring, a quinone ring, an anthraquinone ring, a benzofurane ring, a benzothiophene, an indole ring, and a 1,4-naphthoquinone ring.

16. The object according to any one of the claims 11-15, wherein the aromatic or heteroaromatic ring or ring system comprises a heteroaromatic ring.

17. The object according to any one of the claims 11-16, wherein the one or more compounds include at least one compound selected from the group consisting of 3,4-ethylenedioxythiophene, piperonylamine, piperonyloyl chloride, safrole, 3,4-ethylene-dioxypyrrole, 3,4-ethylenedioxy-N-methylpyrrole, and 3,4-methylenedioxythiophene.

18. The object according to any one of the claims 11-17, wherein the substrate is selected from organosiloxane-based materials, glasses, silicon and fluoro-polymers.

19. The object according to any one of the claims 11-18, wherein the plasma-polymerised layer has a thickness of in the range of 5-200 nm.

20. An object comprising a substrate having a layer of a polymeric material on at least a part of the surface thereof, said polymeric material having pendant heteroaromatic rings or ring systems, and said polymeric material being covalently bonded to the substrate.

21. The object according to claim 20, wherein the layer of the polymeric material has a thickness of in the range of 5-200 nm.

22. The object according to any one of claims 20-21, wherein said polymeric material is a polymer of one or more compounds including at least one polycyclic compound, said polycyclic compound(s) comprising a non-aromatic heterocyclic ring fused to a heteroaromatic ring or ring system, wherein said heteroaromatic ring or ring system gives rise to the pendant heteroaromatic rings or ring systems of said layer of polymer material.

23. The object according to any one of claims 20-22, wherein said polymeric material is a plasma-polymerised material.

24. The object according to any one of claims 20-23, which comprises a substrate of an organosiloxane-based material, wherein at least a part of the surface of said substrate is coated with a layer of a non-organosiloxane-based polymeric material including pendant heteroaromatic rings or ring systems.

25. The object according to any one of claims 20-24, which comprises a substrate of glass, wherein at least a part of the surface of said substrate is coated with a layer of a non-organosiloxane-based polymeric material including pendant heteroaromatic rings or ring systems.

26. The object according to any one of claims 20-25, which comprises a substrate of silicon, wherein at least a part of the surface of said substrate is coated with a layer of a polymeric material including pendant heteroaromatic rings or ring systems.

27. The object according to any one of claims 20-26, which comprises a substrate of a fluoro-polymer, wherein at least a part of the surface of said substrate is coated with a layer of a polymeric material including pendant heteroaromatic rings or ring systems.

28. A method for the preparation of a layer of an electrically conducting material on at least a part of the surface of a substrate, said method comprising the steps of:

(a) providing a substrate wherein at least a part of the surface is coated with a layer of a polymeric material including pendant heteroaromatic rings or ring systems and where said polymeric material is covalently bonded to the substrate;

(b) reacting said pendant heteroaromatic rings or ring systems with one or more second heteroaromatic compounds so as to form a layer of an electrically conducting material including the pendant heteroaromatic rings or ring systems and the second heteroaromatic compounds.

29. The method according to claim 28, wherein step (b) includes an oxidative polymerisation reaction involving the pendant heteroaromatic rings or ring systems and the second heteroaromatic compounds.

30. The method according to any one of claims 28-29, wherein the one or more second heterocyclic compounds include a compound selected from a thiophene compound, a pyrrole compound, a furan compound, and an aniline compound.

31. The method according to any one of claims 28-30, wherein the layer of the electrically conducting material has a total thickness of in the range of 20-5000 nm.

32. The method according to any one of claims 28-31, wherein the layer of the polymeric material is a plasma-polymerised layer.

33. The method according to any one of claims 28-32, the wherein the substrate provided in step (a) is as defined in any one of claims 20-27.

34. An object comprising a substrate, wherein at least a part of the surface of said substrate is coated with a layer of a polymeric material and, integrated therewith, an electrically conducting material, said polymeric material being covalently bonded to the substrate and having pendant heteroaromatic rings or ring systems, and said electrically conducting material being the reacting product of the pendant heteroaromatic rings or ring systems of the polymeric material and one or more second heteroaromatic compounds.

35. The object according to claim 34, wherein the layer of the polymeric material and the electrically conducting material has a total thickness of in the range of 25-5000 nm.

36. The object according to any one of claims 34-35, wherein said polymeric material is a polymer of one or more compounds including at least one polycyclic compound, said polycyclic compound comprising a non-aromatic heterocyclic ring fused to a heteroaromatic

ring or ring system, wherein said heteroaromatic ring or ring system gives rise to the pendant heteroaromatic rings or ring systems of said layer of polymer material.

37. The object according to any one of claims 34-36, wherein said polymeric material is a plasma-polymerised material.

38. The object according to any one of claims 34-37, wherein the substrate with the layer of a polymeric material including pendant heteroaromatic rings or ring systems is as defined in any one of claims 20-27.

39. The object according to any one of claims 34-38, wherein the conductivity of the electrically conducting material is at least 0.01 S/cm.

40. A process of lift-off microstructuring of a polymer on a substrate, said process comprising the steps of:

(a) providing the substrate having a sacrificial layer in a predetermined micro-pattern;

(b) depositing one or more layers of polymer material on the sacrificial layer/substrate; and

(c) dissolving/etching the underlying sacrificial layer (lift-off),

wherein the polymeric material is prepared as defined in any one of claims 1-10.

41. The process according to claim 40, wherein said process comprising the steps of:

(a) spinning a UV-sensitive photoresist on the substrate;

(b) masking the resist with a predetermined pattern and exposing the resist to UV light through the mask;

(c) developing the resist;

(d) depositing one or more layer(s) of polymer material on the resist/substrate; and

(e) dissolving the underlying UV-sensitive photoresist (lift-off).

42. The process according to any one of claims 40-41, wherein the layer of the polymeric material includes pendant heteroaromatic rings or ring systems.

43. The process according to claim 42, which comprises the further step of reacting said pendant heteroaromatic rings or ring systems with one or more second heteroaromatic compounds so as to form a layer of an electrically conducting material.

44. The process according to claim 43, wherein the reaction includes an oxidative polymerisation reaction.

45. The process according to claim 44, wherein the conductivity of the electrically conducting material is at least 0.01 S/cm.

46. The process according to any one of claims 40-45, wherein the layer of the electrically conducting material has a total thickness of in the range of 20-400 nm.

47. The process according to any one of claims 40-46, wherein the layer of the polymeric material is a plasma-polymerised layer.

48. The process according to any one of the claims 40-47, wherein the sacrificial layer on the substrate comprises a mask with a complementary pattern of holes, said pattern corresponding to that of the microstructure to be deposited on the substrate, said holes being adapted to expose corresponding parts of the substrate and adapted to receive deposition material.

49. A process according to any one of the claims 40-48, wherein the process steps are repeated two or more times.